

Department of Energy Laboratory Plan For the Office of Science's Brookhaven National Laboratory

Mission/Overview

Established in 1947, Brookhaven National Laboratory (BNL) originated as a nuclear science facility. Today, BNL maintains a primary mission focus in the physical sciences, energy sciences, and life sciences, with additional expertise in environmental sciences, energy technologies, and national security. BNL brings specific strengths and competencies to the Department of Energy (DOE) laboratory system to produce excellent science and advanced technologies, safely and environmentally responsibly, with the cooperation and involvement of the local, national, and scientific communities. In support of its Office of Science (SC) mission, BNL builds and operates major scientific facilities. These facilities serve not only the basic research needs of the DOE, but they reflect BNL and DOE stewardship of national research infrastructure that is made available on a competitive basis to a wide range of university, industry and government researchers. The Relativistic Heavy Ion Collider (RHIC) complex and the National Synchrotron Light Source (NSLS) are the two facilities that account for most of the 4300 scientists/year served at BNL. To date, six Nobel Prizes have been awarded for discoveries made at the Laboratory.

Laboratory Focus/Core Competencies

Five core technical competencies underpin activities at Brookhaven National Laboratory:

1. Conceptualization, design, construction, and operation of advanced accelerator systems, detectors, magnets, and instrumentation
2. Synchrotron radiation science and technology
3. Imaging (including radiotracer chemistry, biological structure, and instrumentation)
4. Development and application of advanced software and computing facilities to high energy and nuclear physics experiment and theory
5. Synthesis and characterization of complex and nano-structured materials.

Lab-at-a-Glance

Location: Upton, NY

Type: Multi-program lab

Contract Operator: Brookhaven Science Associates

Responsible Field Office: Brookhaven Site Office

Website: <http://www.bnl.gov/>

SC Physical Assets:

- 5320 acres and 341 buildings
- 4.0M GSF in Active Operational Buildings
- 69K GSF in Non-Operational Buildings
- 2007 Replacement Plant Value: \$1.754B
- Deferred Maintenance: \$107M
- Asset Condition Index:
 - Mission Critical 0.94 (Adequate)
 - Mission Dependent 0.93 (Adequate)
- Asset Utilization Index: 0.98 (Good)

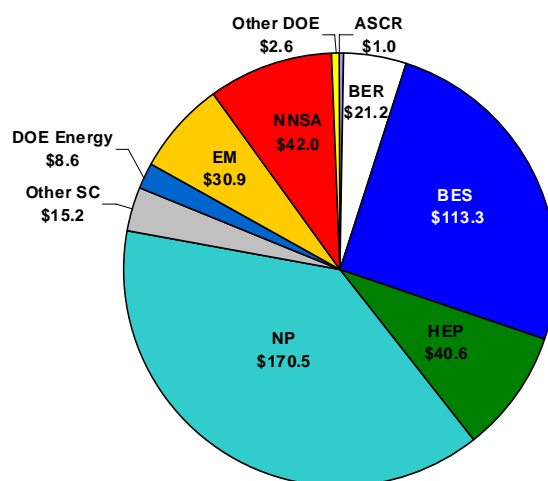
Human Capital:

- 2600 full time employees (9/30/07)
- 2700 full time employees (3/31/08)
- 4300 Facility Users and Visiting Scientists

FY 2007 Total DOE Funding: \$445.8M

FY 2007 DOE Funding by Source

(BA in Millions):



FY 2007 Non-DOE Funding: \$43.7M

FY 2007 Dept. Of Homeland Security: \$3.2M

The Office of Science believes that these five competencies will enable BNL to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and/or to pursue its vision for scientific excellence and pre-eminence in the following areas:

- Relativistic heavy ion and spin physics research to understand the essence of nuclear matter
- Photon sciences for advanced characterization of functional nanomaterials for energy technology applications
- Energy-related research and development (R&D) to enable breakthroughs in the effective use of renewable energy through improved conversion, transmission, and storage
- High energy physics at the energy, precision, and cosmology frontiers, supplemented by theory and advanced accelerator R&D
- Understanding normal and pathological physiology of plants and animals through imaging.

Business Lines/Distinguishing Characteristics

The following capabilities, aligned by business lines, distinguish BNL and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the Laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of BNL and its role within the Office of Science laboratory complex. Items in italics within the Distinguishing Capabilities column identify research facilities that convey particular strategic strengths and capabilities to the Laboratory. Descriptions of these facilities are available at the website noted in the Lab-at-a-Glance section of this Plan.

Business Line	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Collective QCD Phenomena	<ul style="list-style-type: none"> • Relativistic heavy ion physics; • Polarized proton spin studies; • Quantum Chromodynamics (QCD) theory; • High Performance Computing in Lattice QCD; • Accelerator design and R&D in advanced beam cooling techniques and energy recovery linacs; • Advanced detector instrumentation & electronics; • <i>Relativistic Heavy Ion Collider (RHIC)</i>; • <i>RHIC Computing Facility</i>. 	<p>RHIC, a unique world-class accelerator facility for colliding intersecting symmetric or asymmetric beams of nuclei and polarized protons;</p> <p>Serves ~1000 international users/yr; 29 of the 50 most cited <i>nucl-ex</i> papers ever;</p> <p>Alternating Gradient Synchrotron (AGS) Booster delivers dedicated Heavy Ion beams to new NASA Space Radiation Laboratory (NSRL); highest performance rating from National Aeronautics and Space Administration (NASA);</p> <p>RIKEN-BNL Research Center for strong interactions and spin physics;</p> <p>The discovery of the Quark Gluon Plasma (a new state of strongly interacting matter) with near-perfect liquid properties; cited by the American Institute of Physics and others as the top physics story of 2005;</p> <p>Nuclear theory group: >12000 citations.</p>	<p>Search for and characterize quark-gluon plasma.</p> <p>Understand the structure of the nucleon.</p> <p>Pursue advanced accelerator technology.</p>
Photon Sciences	<ul style="list-style-type: none"> • Novel X-ray and Ultraviolet/Infrared techniques; • Innovative detectors for photons; 	<p>2003 Nobel Prize in Chemistry for research conducted at NSLS;</p> <p>Development of the Chasman-Green</p>	<p>Advance core disciplines of basic energy sciences.</p>

Business Line	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
	<ul style="list-style-type: none"> • <i>National Synchrotron Light Source (NSLS)</i>; • <i>NSLS-II Project</i>; • <i>Joint Photon Sciences Institute (JPSI)</i> ; • <i>Source Development Laboratory</i>. 	<p>lattice, used in all modern synchrotrons;</p> <p>NSLS serves >2400 users/yr; >800 publications/yr;</p> <p>Development of in-vacuum insertion devices; invention/demonstration of seeded free-electron lasers based on High Gain Harmonic Generation;</p> <p>Design of NSLS-II to have 1nm spat. res.; 0.1 meV energy res.; world's highest brightness.</p>	<p>Lead nanoscale science revolution (BNL's focus is to promote U.S. energy security).</p> <p>Pursue advanced accelerator technology.</p>
Energy Sciences	<ul style="list-style-type: none"> • Strongly correlated and complex materials research, including superconductors; high-quality materials synthesis; • Application of X-ray, ultraviolet/infrared, electron and neutron scattering techniques to materials studies; Advanced Electron Microscopy Institute; • Nanostructured fuel cell electro-catalyst science; <i>in situ</i> studies of catalytic chemical processes; Synchrotron Catalysis Consortium (SCC); • Bioengineered enzyme optimization of plant-oil production; • Market Allocation Model (MARKAL); • Nuclear energy and infrastructure systems; • <i>Center for Functional Nanomaterials (CFN)</i>; • <i>National Synchrotron Light Source (NSLS)</i>; • <i>National Nuclear Data Center</i>. 	<p>Since discovery of high Tc superconductors and start of BNL's strongly correlated electron program in 1987, BNL has produced 50 papers with >200 citations, of which 7 papers have >500 citations (with 3>1000 citations);</p> <p>Invention of new nanocatalysts for fuel cell hydrogen oxidation anodes and oxygen reduction cathodes with an order of magnitude lower Pt loading, which has met the DOE 2010 activity targets;</p> <p>In 2006/7, the SCC served 128 users from 33 institutions, resulting in 32 papers;</p> <p>Plant oil production program highly cited; an average of 39.5 citations per article;</p> <p>MARKAL used in ~40 countries for energy planning and environmental policy analysis, and by the DOE Office of Policy, etc.;</p> <p>Recognized leader in structural, human performance, probabilistic risk, and accident analysis;</p> <p>National Nuclear Data Center: data retrievals (~1.5 million in FY 2007) far exceed that of any nuclear data center.</p>	<p>Advance core disciplines of basic energy sciences.</p> <p>Master control of energy-relevant complex systems.</p> <p>Lead nanoscale science revolution to promote U.S. energy security.</p> <p>Understand structure of nucleonic matter for development of applied technologies (power plants, national security, and medicine).</p> <p>Promote American's energy security through reliable, clean, and affordable energy.</p> <p>Regulate the safe and secure use and management of radioactive materials for the public good.</p>
Physics Beyond the Standard Model	<ul style="list-style-type: none"> • Detector expertise in calorimeter and muon systems (U.S. ATLAS detector for the Large Hadron Collider (LHC)); • Low noise electronics and innovative detectors for particles and photons; • Quantum Chromodynamics on a Chip (QCDOC) and High Energy Theory; • Fabrication of high Tc magnets; 	<p>Five Nobel Prizes in Physics awarded for discoveries in particle physics - one for physics Beyond the Standard Model;</p> <p>Host Laboratory for U.S. ATLAS, playing key role in transition from construction project to research for U.S. ATLAS;</p> <p>Leading role in proposal of Homestake as location for Deep Underground Science and Engineering Laboratory (DUSEL) and the next-generation long-baseline neutrino oscillation experiment with Fermilab;</p>	<p>Search for possible Physics Beyond the Standard Model and extend it to an all-inclusive theory.</p> <p>Pursue advanced accelerator technology.</p>

Business Line	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
	<ul style="list-style-type: none"> • <i>Accelerator Test Facility (ATF);</i> • <i>U.S. ATLAS Tier I Computing Facility and Analysis Support Center;</i> • <i>Alternating Gradient Synchrotron (AGS).</i> 	<p>Leadership roles in project management and antineutrino detector design, muon tracker, and liquid scintillator for Daya Bay Experiment; leadership role in development of a muon collider/neutrino factory;</p> <p>Home to ATF, the 1st user facility for advanced accelerator research toward long-term R&D of particle and laser beams;</p> <p>AGS precision measurement of muon anomalous magnetic moment provides strongest hint for a TeV-scale modification of the Standard Model, with more than 1300 citations since 2000.</p>	
Biological, Environmental, and Climate Sciences	<ul style="list-style-type: none"> • Development of radiotracers and instrumentation for imaging plants and animals; Positron Emission Tomography (PET)/functional Magnetic Resonance Imaging (fMRI) for translational neuroimaging focused on addiction; • Structural Biology: X-ray and cryo-electron microscopy (EM) of molecular complexes; • Significant capabilities in clouds and aerosol research; Operation of Free Air Carbon Dioxide Enrichment (FACE) experiments; • <i>Protein Crystallography Research Resource (PXRR);</i> • <i>Cryo-EM; Scanning Transmission Electron Microscopy (STEM).</i> 	<p>Leader in addiction research as determined by honors (National Academy of Sciences, Presidential Early Career Awards for Scientists and Engineers, American Association for the Advancement of Science Symposium, etc.);</p> <p>New cocaine addiction treatment in Phase II clinical trials, with remarkable effectiveness in first completed trial;</p> <p>Leadership in photon science in structural biology from the large number of Protein Data Bank entries;</p> <p>Chief scientists for the DOE Atmospheric Science and Atmospheric Radiation Measurement (ARM) Programs;</p> <p>Operates ARM External Data Center.</p>	<p>Master the convergence of physical and life sciences for health & medicine.</p> <p>Unravel mysteries of earth's changing climate.</p>
National and Homeland Security	<ul style="list-style-type: none"> • Simulation of atmospheric movement of contaminants using Perfluorocarbon Tracers (PFTs); • Pioneering development of gamma ray spectrometers and neutron imaging and directional detectors; • Long-range detection of special nuclear materials; • Radiological Assistance Program (RAP). 	<p>PFTs used in urban dispersion measurements in New York City, and Washington, DC;</p> <p>External awards for innovative radiation detectors to staff members; staff member elected to Presidential Chain of SPIE;</p> <p>Region I coordinating office for RAP (responds to requests from DOE programs and state, local, and tribal governments).</p>	<p>Ensure America's nuclear security.</p> <p>Preserve our freedoms and protect America.</p>

Science Strategy for the Future/Major Activities

Anticipated scientific discoveries at Brookhaven will drive U.S. competitiveness, inspire America, and transform the technologies that meet the Nation's energy requirements. The Laboratory's major activities for the coming decade will focus on two principal missions: the application of photon sciences and nanomaterials research to energy sciences and the advancement of fundamental research in nuclear and particle physics to gain a deeper understanding of matter, energy, space, and time.

In order to reap the potentially transformational benefits of these missions, Brookhaven is pursuing the evolution of its two largest user facilities – the NSLS and RHIC. NSLS, a pioneering user facility, is an accelerator-based light source for photon sciences. It remains productive after more than 25 years of operation. The discovery potential of BNL photon science will be enormously expanded by replacing NSLS with NSLS-II, a new light source, by 2015. It will deliver the world's finest capabilities, ~10 times better than any other synchrotron now operating or under construction, and with 1,000 times higher sensitivity. Together with the newly completed Center for Functional Nanomaterials (CFN), NSLS-II will transform Brookhaven's research in energy sciences. RHIC is an accelerator that collides beams of atomic nuclei at unprecedented energies, where quarks and gluons can be released from their normal confinement inside protons and neutrons. Since the start of operations in 2000, RHIC experiments have transformed our understanding of the matter that forms the visible universe, including the form and behavior of that matter at the extreme temperatures reached a tiny fraction of a second after the Big Bang. To pursue these fundamental studies on a more comprehensive scale, RHIC will be evolved first into RHIC II and then into a facility (eRHIC), capable of exposing the intense force field predicted to lie at the heart of ordinary matter and to underlie the discoveries at RHIC.

Four major activities will extend and evolve BNL's current business lines, to support the DOE Strategic Themes in Energy Security, Nuclear Security, Scientific Discovery and Innovation, and Environmental Responsibility and to build on core strengths and capabilities of the Laboratory. These are areas in which BNL envisions that it will substantially distinguish itself by offering new capabilities. In their order of priority, these activities are as follows:

1. Photon sciences
2. Collective QCD Phenomena
3. Energy sciences → 21st Century Materials and Sources for Energy
4. Physics Beyond the Standard Model → Physics of the Universe.

Infrastructure

Overview of Site Facilities and Infrastructure

BNL is located in Upton New York in central Suffolk County approximately 75 miles east of New York City. The BNL site, former Army Camp Upton, lies in both the Townships of Brookhaven and Riverhead. BNL is situated on the western rim of the shallow Peconic River watershed. The marshy areas in the site's northern and eastern sections are part of the Peconic River headwaters. Thirty percent of BNL's 5,320 acre site is developed.

There are 349 buildings totaling 4278 thousand square feet (ksf) (including 14 Environmental Management (EM), totaling 175 ksf and 335 SC totaling 4092 ksf). In addition, there are 208 portable structures (including 23 EM and 185 SC, totaling 8 ksf and 63 ksf, respectively). The average age of active buildings is 44 years (46 years for EM and 44 years for SC). Seventy-two buildings (901 ksf) date back to World War II (WW II) and most major permanent science facilities, excluding those constructed for NSLS, RHIC and the CFN, are DOE-SC facilities built in the 1950s and 1960s. For the

most part these facilities have not received any major renovation and many building systems are original.

The current Land Use Plan can be found in [Appendix A of the Ten Year Site Plan, July 2007](#). In FY09, BNL plans to add 6000 sf for an expansion of the Brookhaven Computing Facility at Bldg 515 and 8000 sf for an expansion of the Central Chilled Water Facility, Bldg 600. In FY10, BNL plans to add 10000 sf of office space adjacent to the central warehouse Bldg 98 to allow for the relocation of staff in the Procurement and Property Management Division, Bldg 355, prior to its demolition. In addition, BNL will construct a 1000 sf new Main Gate Access Facility.

SC Infrastructure Data Summary

Replacement Plant Value (\$M)		3,127
Total Deferred Maintenance (\$M)		108
Asset Condition Index	MC	0.94
	MD	0.93
	NMD	0.99
Asset Utilization Index	Office	1.00
	Warehouse	1.00
	Laboratory	0.99
	Housing	1.00
FY07 Actual Maintenance (\$M)		27

Facilities and Infrastructure to Support Laboratory Missions

As indicated in the table below, the major issue confronting BNL and the mission readiness of its business lines is the need for capital renewal. Many buildings are in excess of 45 years old and require substantial investments in roofing and mechanical and electrical system upgrades. Research labs are in need of state-of-the-art upgrades including fume hoods, casework, and clean rooms. BNL has identified those “permanent” facilities that will form the platform for current and future business lines and has invested over \$30M of General Plant Projects (GPP) and operating funds over and above routine maintenance in these facilities over the past ten years. In addition, the current Renovate Science Labs (RSL) I project will invest an additional \$18M in these facilities. These permanent facilities are well-designed and structurally sound. With the planned investments indicated, their ability to support world-class science can be extended significantly. Some capabilities of existing programs are hampered by the lack of high-accuracy labs and BNL has proposed to provide new facilities to address these needs. BNL’s direct investment in conjunction with Line Item support through the Science Laboratories Infrastructure (SLI) program will ensure BNL’s leadership roles within the SC Laboratory Complex.

Facilities and Infrastructure to Support Laboratory Business Lines

Business Line	Facilities and Infrastructure	Summary Condition Evaluation	Planned Investments
Collective QCD Phenomena <ul style="list-style-type: none"> • Relativistic heavy ion physics; • Polarized proton spin studies; • Quantum Chromodynamics (QCD) theory; • High Performance Computing in Lattice QCD; • Accelerator design and R&D in advanced beam cooling 	<ul style="list-style-type: none"> • B/510, RHIC • B/510, RHIC • B/510, 515 • B/510, 515 • B/510, 515, 911, 912 	<i>See Note 1 below</i> The consolidation of RHIC support staff from older less desirable facilities into upgraded and more efficient facilities will allow demolition of ~ 19 ksf, and will reduce the	Line Items <ul style="list-style-type: none"> - Renovate Science Labs II (RSL II) B/510 (FY10) - Central Computing Building (FY17) GPP <ul style="list-style-type: none"> - Upgrade Sigma 7 Computer Room B/510 (FY08) - Brookhaven Computing Facility (BCF) Data Center Expansion (FY08)

Business Line	Facilities and Infrastructure	Summary Condition Evaluation	Planned Investments
techniques and energy recovery linacs; • Advanced detector instrumentation & electronics; • <i>Relativistic Heavy Ion Collider (RHIC)</i> ; • <i>RHIC Computing Facility</i> .	• B/510, 535 • Most 900 & 1000 Series Bldgs. • B/515	deferred maintenance backlog. Computing expansion is currently being addressed with the addition of new space and conversion of existing space next to the BCF in B/515.	IGPP - Sprinkler Protection B/510 High Bay (FY16) - Backup Chilled Water BCF B/515 (FY14) - Temp/Humidity Control Modifications, Printed Circuit Lab B/535 (FY12) - Ductless A/C B/535 Rooms B-108A, B-108B, B-113, B-113A (FY14) - B/911 Rehab Cooling Water Supply (FY15) Operating including Deferred Maintenance Reduction - <i>See Note 2 below</i>
Photon Sciences • Novel X-ray and Ultraviolet/Infrared techniques; • Innovative detectors for photons; • <i>National Synchrotron Light Source (NSLS)</i> ; • <i>NSLS-II Project</i> ; • <i>Joint Photon Sciences Institute (JPSI)</i> ; • <i>Source Development Laboratory</i>	• B/725 (NSLS) • B/535, 703, 725 • B/725 (NSLS) • B/703, 740 (NSLS-II) • B/745 (JPSI) • B/729	<i>See Note 1 below</i> B/703, 725, and 729 are adequate to support the business lines with some capital renewal anticipated. NSLS-II (B/740) & JPSI (B/745) are future construction.	Line Items - NSLS-II GPP - None IGPP - None 3rd Party (NY State) - JPSI Operating including Deferred Maintenance Reduction - <i>See Note 2 below</i>
Energy Sciences • Strongly correlated and complex materials research; high-quality materials synthesis • Application of X-ray, ultraviolet/infrared, electron and neutron scattering techniques to materials studies; Advanced Electron Microscopy Institute; • Nanostructured fuel cell electro-catalyst science; In situ studies of catalytic chemical processes; Synchrotron Catalysis Consortium (SCC); • Bioengineered enzyme optimization of plant-oil • Market Allocation Model (MARKAL) • Nuclear energy and infrastructure systems; • <i>Center for Functional Nanomaterials (CFN)</i> ; • <i>National Synchrotron Light Source (NSLS)</i> ; • <i>National Nuclear Data Center</i> .	• B/480, 735 (CFN), ISB I • B/480, ISB I • B/555, B/725 (NSLS) • B/463, ISB II • B/475 • B/130 • B/735 • B/725 (NSLS) • B/197	<i>See Note 1 below</i> Some of the work performed under this Business Line cannot progress without new facilities that can provide high-accuracy labs. Existing facilities cannot be renovated to meet these standards. B/130 is currently under renovation to provide a temporary solution as the functions consolidate out of B/475 which is in extremely poor shape. Ultimately the occupants of B/130 and B/197 will consolidate into a new alt. financed office building. B/725 is adequate to support the business lines with some capital renewal.	Line Items - Renovate Science Labs I (RSL I) B/480 (FY07) - Interdisciplinary Science Building I (ISB I) (FY09) - Renovate Science Labs II (RSL II) B/555 (FY10) - Interdisciplinary Science Building II (ISB II) (FY12) - Renovate Science Labs III (RSL III) B/463 (FY18) GPP - Modify Room 112, B/555 for Hot Isostatic Press (FY08) IGPP - Fiber Network Upgrade, B/820 (FY09) - B/463, Renovation of Lab 116 (FY14) - B/463, Renovation of Lab 118 (FY14) - Enclosed Stairways - Basement B/555, Chemistry (FY16) - Bio-Fuels and Radiation Biology Office Addition (FY11) 3rd Party - Alt. Financed Office Building (FY15) Operating including Deferred Maintenance Reduction - <i>See Note 2 below</i> - Damper Corrosion remediation B/555
Physics Beyond the Standard Model • Detector expertise in the calorimeter and muon systems (U.S. ATLAS detector for the Large Hadron Collider (LHC)); • Low noise electronics and	• B/535, 510 • B/535, 510	<i>See Note 1 below</i> B/820 and 902 are adequate to support the business lines with only minor capital renewal anticipated.	See projects listed above for B/510, 515, and 535. There are no major capital projects planned for B/820 or 902. Line Items - No additional

Business Line	Facilities and Infrastructure	Summary Condition Evaluation	Planned Investments
<ul style="list-style-type: none"> innovative detectors for particles and photons; Quantum Chromodynamics on a Chip (QCDOC) and High Energy Theory; Fabrication of high Tc magnets; <i>Accelerator Test Facility (ATF)</i>; <i>U.S. ATLAS Tier I Computing Facility & Analysis Support Center</i>; <i>Alternating Gradient Synchrotron (AGS)</i>. 	<ul style="list-style-type: none"> B/510 B/902 B/820 B/510, 515 Most 900 Series Bldgs. 		<p>IGPP</p> <ul style="list-style-type: none"> No additional <p>Operating including Deferred Maintenance Reduction</p> <ul style="list-style-type: none"> See Note 2 below
<p>Biological, Environmental, and Climate Sciences</p> <ul style="list-style-type: none"> Development of radiotracers and instrumentation for imaging plants and animals; PET/fMRI for translational neuroimaging focused on addiction; Structural Biology: X-ray and cryo-electron microscopy (EM) of molecular complexes; Significant capabilities in clouds and aerosol research; Operating Free Air Carbon Dioxide Enrichment (FACE) experiments; <i>Protein Crystallography Research Resource (PXRR)</i>; <i>Cryo-EM; Scanning Transmission Electron Microscopy (STEM)</i>. 	<ul style="list-style-type: none"> B/490, 510, 555, 560, 901, 906, ISB II B/463, 421, 725 B/815, 490 B/463, 725 B/463 	<p>See Note 1 below</p> <p>B/725 and 906 are adequate to support the business lines with some capital renewal anticipated. The west end of B/901 contains an excess accelerator; BNL has requested EM to accept the facility for decontamination & decommissioning (D&D).</p>	<p>See projects listed above for B/510, 555, and 463.</p> <p>Line Items</p> <ul style="list-style-type: none"> Renovate Science Labs I (FY07) <p>IGPP</p> <ul style="list-style-type: none"> Upgrade Exhaust Hoods in Labs C5 & C7, B/815 (FY09) <p>Operating including Deferred Maintenance Reduction</p> <ul style="list-style-type: none"> See Note 2 below
<p>National and Homeland Security</p> <ul style="list-style-type: none"> Simulation of atmospheric movement of contaminants using Perfluorocarbon Tracers (PFTs); Pioneering development of gamma ray spectrometers and neutron imaging and directional detectors; Long-range detection of special nuclear materials; Radiological Assist. Program (RAP). 	<ul style="list-style-type: none"> B/815 B/197, 815, ISB I (for synthesis & char. of detector materials) B/197, 490 B/750 (Annex) 	<p>See Note 1 below</p> <p>B/197 is a WW II era wood building; ultimately the occupants will be consolidated into a new alt. financed office building.</p> <p>B/750 Annex is adequate to support the business lines with some capital renewal.</p>	<p>Line Items</p> <ul style="list-style-type: none"> Interdisciplinary Science Building I (ISB I) (FY09) <p>3rd Party</p> <ul style="list-style-type: none"> Alt. Financed Office Building
<p>Site Infrastructure</p> <ul style="list-style-type: none"> Electrical Utilities – Power, communications, networking Mechanical Utilities – Steam, Water, Sewage, Chilled Water Central Plants (Steam, Chilled Water, Potable Water, Sewer) Roads & Grounds General administrative support buildings (Major admin 	<ul style="list-style-type: none"> B/449, 603, 515 VARIOUS B/610, 600, 624, 575 VARIOUS B/400, 134, 355, 179, 	<p>The support shops of the F&O Directorate are housed in converted WW II era substandard wood structures and scattered across the site.</p> <p>While utility plants are in adequate condition distribution lines need</p>	<p>Line Items</p> <ul style="list-style-type: none"> Support Shops Complex (FY14) Utilities Improvements (FY15) <p>IGPP</p> <ul style="list-style-type: none"> Central Chilled Water (FY08) Child Development Center Phase II (FY11) Contracts & Procurement Bldg (FY09) B/479 Addition, Relocate Electron Beam Weld Machine (FY11) New Guard Booths, Utilities/Access

Business Line	Facilities and Infrastructure	Summary Condition Evaluation	Planned Investments
buildings) • Housing • Warehousing • Admin Computing	197, 129 • 300 Series (Housing) • B/98 • B/459	<p>selective replacement. Additional central chilled water capability is needed to provide redundancy for existing loads and to serve planned new facilities.</p> <p>Many facilities need improvements to bring them up to current safety and fire protection standards.</p> <p>The existing telephone system is obsolete, limiting needed expansion.</p>	<p>Improvements, Main Gate (FY12)</p> <ul style="list-style-type: none"> - Telephone and Network Improvements (Various) - Steam Manhole Upgrades (Various) - Potable water piping upgrades (Various) - Modifications for ADA Compliance (Various) - Eyewash and Safety Shower Upgrade (Various) - Remove Flammable Foam Duct Insulation – Site-wide (Various) <p>GPE</p> <ul style="list-style-type: none"> - New telephone & voicemail system (TBD) <p>Operating including Deferred Maintenance Reduction</p> <ul style="list-style-type: none"> - See Note 2 below

Note 1: Buildings B/463, 480, 490, 510, 515, 535, 815, 901, & 911 require significant capital renewal. Needed replacements include roofs, air-handlers, and fire alarm control panels, as well as rehab of elevators and correction of OSHA deficiencies. In addition, individual labs need to be rehabilitated with new floors, ceilings, lighting, fume hoods, and casework.

Note 2: Operating and Deferred Maintenance: Capital renewal investment (replacement like-in-kind) of buildings systems is a continuing process throughout the planning period. Note applies to B/463, 480, 490, 510, 515, 535, 815, 901, & 911.

Strategic Site Investments

In order for the Laboratory to continue as a world leader in science and technology, it will be necessary to address critical infrastructure concerns. Paramount to this objective is implementation of infrastructure renewal, i.e., upgrades and enhancements needed to support the expanding scientific and technological base and providing reliable uninterrupted utility services with sufficient reserve capacities to support future planned growth. In addition, the Laboratory must provide world-class facilities that will support the recruitment and retention of a premier staff. Many of the current buildings and laboratories are of 1950s and 1960s vintage. Upgrades and/or renovations to meet scientific needs, such as for high-accuracy and with heating, ventilation and air conditioning (HVAC), would not be cost-effective or, in some cases, possible. Replacement is often the most cost-effective alternative.

In response to the Laboratory's scientific priorities, infrastructure projects were formulated as listed in the Integrated Facilities and Infrastructure (IFI) Crosscut in order to maintain and upgrade mission-essential facilities and to provide new ones, where warranted. Completing these projects will enable BNL to realize its mission and to meet the goals expressed in the *Department of Energy's Strategic Plan 2006*. BNL expects that they will be funded from the following sources:

- **Infrastructure-related Line Items.** Over the next ten years as part of the SC Infrastructure Modernization Initiative, BNL has proposed projects that will help to achieve the goals identified as part of its Site Master Plan process. The projects can be categorized as those providing new modern facilities where it is not cost effective to rehabilitate and upgrade existing ones; those which will rehabilitate and upgrade permanent buildings where the functional layout meets current and anticipated program needs; and those which will modernize utilities to ensure continued high-reliability. The projects are as follows (all costs in at-year dollars):
 1. **New facilities:** BNL has proposed an Interdisciplinary Science Building (ISB) complex consisting of two buildings to be constructed in phases. ISB I with a project start in

FY09 has a Total Estimated Cost (TEC) of \$66.3M and ISB II with a proposed project start of FY12 has a TEC of \$69.7M.

2. Rehabilitation and upgrade of BNL's major lab/office buildings: BNL proposed phasing this work over three projects during the ten year planning period. The initial phase began in FY07 and has a TEC of \$18M; the next two phases are proposed to start in FY10 and FY18 with TECs of \$50M and \$55M respectively.
3. Other projects including replacement of support shops, now housed in WW II era wood buildings and utilities improvement projects have been proposed, toward the end of the ten-year planning period.
4. In addition to SLI-funded Line Items, BNL will build the BES program-funded NSLS-II project (conventional facilities portion at a cost of ~\$240M) and the New York State (NYS)-funded JPSI (~\$30M). These projects include funds to improve infrastructure as required, so as not to have a negative impact on existing infrastructure.

Screening Criteria	ISB I & II	Renovate Science Labs II
Project is dedicated to core site infrastructure needs and should not serve to increase capacity of facilities or utilities to handle new programmatic scope.	General-purpose lab/office buildings which will be used by several existing DOE programs to support currently funded work.	Project renovates core building systems and space for existing BES, BER, HEP, and NP programs.
Project cannot be accomplished using an alternative financing approach.	Lab buildings are less attractive to developers for commercial reuse; building needs to be located in close proximity to existing science buildings, which are remote from the site boundary.	As a renovation of an existing DOE building, this project is not suitable for alternate financing, other than to use Energy Savings Performance Contract (ESPC) investments to leverage the project.
Project is large in scope and beyond the reach of Institutional General Plant Project (IGPP) funds.	The ISB I and II Project costs of \$66M and \$69M, respectively are far above the IGPP limit.	As a large renovation project (\$32M in B/510 and \$18M in B/555), SLI funding is the most suitable funding source.
Project proposal is sufficiently mature to allow a reasonable estimate of scope, cost, schedule, and risks.	Project scope, cost and schedule have been developed using BNL's past experience in building lab/office space, with support from an outside Architectural/Engineering (A/E) firm.	Project scope, cost and schedule have been developed using BNL's recent experience in renovation work with support from an outside A/E firm.
Selection Criteria	ISB I & II	Renovate Science II
Mission Relevance – The relevance of the project to DOE's missions, their priority & scale.	Provides high-accuracy space for 21st-century research. Functional work environment for several programs focusing on Energy.	Buildings are "Mission Critical" facilities & support major BNL programs.
Deferred Maintenance (DM) – The amount of deferred maintenance the project will eliminate.	The value of the wood buildings being demolished and other deferred maintenance for each project is ~\$15M - \$20M.	This project reduces BNL needs on a dollar-for-dollar basis (DM and Rehabilitation and Improvement Cost (RIC) \$50M).
Elimination of Excess – The amount of excess facilities that is eliminated by the project scope.	Projects include demolition of space in excess of space being constructed.	As a renovation project, it does not reduce the BNL footprint.
Return on investment – The project's benefits in relation to the project's cost.	The project will improve the operational efficiency of scientists who use the labs and save energy through more efficient building systems.	The project will improve the operational efficiency of scientists who use the labs and save energy through more efficient building systems.
Institutional Commitment – The level of commitment to the project	BNL has made an institutional commitment to spend \$80M in IGPP	BNL has made an institutional commitment to spend \$80M in IGPP and

Screening Criteria	ISB I & II	Renovate Science Labs II
exhibited by the Laboratory.	and \$50M in Deferred Maintenance Reduction (DMR) over the next 10 years.	\$50M in DMR over the next 10 years.

- **General Plant Projects.** These projects (GPP for FY07 & FY08, IGPP for FY09 and beyond) projects will average \$7.3M per year. These projects will help meet the immediate needs of BNL's business lines, and reduce the backlog of non-line item capital construction needs. Several projects will be constructed to support and complement the proposed line items initiatives, such as those that will help to free up preferred building sites for new line item projects, and projects which complement the rehabilitation and upgrade line item projects.
- **Deferred maintenance reduction (DMR).** The target for FY08 is \$5.4M, rising to \$10.3M in FY10 and then reducing to zero in FY15 when it is expected that the DOE facility Asset Condition Index (ACI) goal will be achieved. The overall maintenance budget will remain at 2% of Replacement Plant Value (RPV). As building RPVs have increased sharply due to rapidly rising construction cost escalation, maintenance budget targets will also increase sharply and are expected nearly to double in the planning period (excludes the impact of NSLS-II).
- **Environmental Liabilities.** In response to a call from the DOE Office of Environmental Management (EM) for new clean up scope, BNL submitted for consideration \$91M in unfunded environmental projects, which are currently a liability to SC. These projects included demolition of Buildings 491 (the Brookhaven Medical Research Reactor - BMRR) (\$23M), 650 (\$7.6M), 810 (\$3.6M), 811 (\$3.6M), 830 (\$16.1M), 901-West End (\$7.6M), and 901A (\$7.6M). Also submitted were projects for clean-up of contaminated media at the Shotgun Range (\$2.2M) and disposal of excess contaminated materials (\$19.7M). The near-term end state for the Brookhaven Graphite Research Reactor (BGRR) is the removal of the pile/bioshield and construction of an engineered cap by 2010 at a cost of \$38M. The near-term end state for the High Flux Beam Reactor (HFBR) is the removal of the control rod blades and beam plugs, and restoration of the waste loading area by FY09, at a cost of \$11M. In the long-term, the facilities will revert back to SC for surveillance and maintenance.
- **Third Party.** Consistent with the plan presented to DOE for the SC Infrastructure Modernization Initiative, BNL has proposed a complementary project for an alternately-financed office building to complete the replacement of WW II era wood office buildings. The project would be developed for the later part of the planning period and would be in the 60-80 ksf range.

BNL has a deferred maintenance (DM) backlog of \$108M, and a rehabilitation and improvement cost (RIC) backlog of \$205M. In addition, new infrastructure projects are likely to be identified over the planning period to address emerging scientific needs and the findings of continued facility condition inspections.

To meet the infrastructure challenges, BNL has formulated the following strategies to meet the immediate needs of its staff and facility users:

- Construct new state-of-the-art research facilities (e.g. high-accuracy labs) that facilitate collaboration and support interdisciplinary research teams, where existing buildings cannot be retrofitted – feasibly or economically.
- Maintain quality workplaces for employees and users through rehabilitating, renovating and upgrading those permanent buildings that can readily support current and future missions.
- Continue to defer major investments in 60-year-old wood buildings (mostly used by support staff) while performing minimum maintenance to keep these buildings operational and safe. When opportunities arise, consolidate staff from these old wood structures and demolish them.

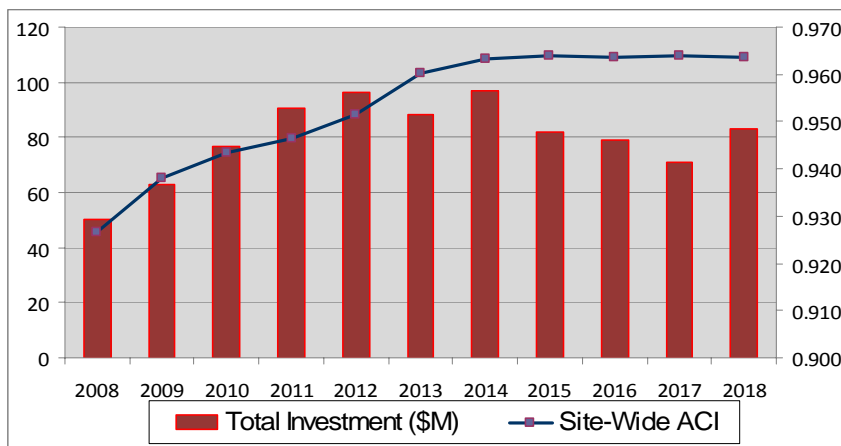
- Pursue alternative financing for new buildings. BNL will investigate alternative financing for a new support staff office building.
- Use planning teams composed of engineering and site maintenance staff to identify and recommend strategies for maintaining utility system reliability at minimum cost.
- Continue to work with NYS and the New York Power Authority (NYPA) to obtain power at a reasonable cost.
- Continue to develop strategies that will address, in a cost-effective manner, the various energy reduction and sustainable design goals from DOE. These will include:
 1. Operate the utility plants in the most cost-effective manner, taking advantage of fuel storage and fuel switching capabilities.
 2. Increase emphasis on maintenance of energy consuming systems to increase efficiency.
 3. Develop energy and water consumption conservation projects to reduce energy and water use and enhance operations. Constellation Energy has proposed an Energy Savings Performance Contract (ESPC) which is under evaluation by BNL.
- Work with local and state regulators to prioritize environmental liability issues.
- Prioritize all proposed investments in infrastructure and Environment, Safety & Health and program them to maximize the value of BNL's infrastructure, reduce risk, and support the science programs.

Trends and Metrics

Brookhaven has achieved all previous Maintenance Investment Index (MII) targets and often exceeded them. In FY06, BNL achieved 112% of the target and in FY07 102% of target. FY07 was the first year for the DMR program. Due to the extended Continuing Resolution and resulting budget cuts, BNL was able to achieve only 64% of the original target. BNL is on track to meet FY08 targets.

BNL expects to achieve a site wide ACI of 0.96 by FY13. While BNL's project prioritization process does not have individual goals for Mission Critical and Mission Dependent facilities, mission needs are considered in the process and favor Mission Critical facilities in funding decisions. With the focus on Mission Critical Facilities, the ACI for those facilities will be even higher.

Facilities and Infrastructure Investments (\$M) - Impact to Asset Condition Index											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Maintenance	28.5	33.2	34.3	34.3	35.6	37.1	38.6	41.1	42.4	44.2	45.5
DMR	5.4	8.1	10.3	10.0	10.0	8.5	6.0	0	0	0	0
EFD (Overhead)	1.0	0	0	0	0	0	0	0	0	0	0
IGPP	0.4	6.8	7.1	7.3	7.6	7.8	8.1	8.4	8.7	9.0	9.3
GPP	6.6	0	0	0	0	0	0	0	0	0	0
Line Items (SLI)	8.2	14.9	25.0	39.0	43.0	35.0	44.0	32.2	27.8	17.5	28.5
Total Investment	50.1	63.0	76.7	90.6	96.2	88.4	96.7	81.7	78.9	70.7	83.3
Estimated RPV	1,461	1,698	1,755	1,756	1,822	1,900	1,976	2,102	2,168	2,263	2,331
Estimated DM	107.3	105.1	99.5	93.9	88.1	75.3	72.7	76.1	79.1	81.3	85.1
Site-Wide ACI	0.93	0.94	0.94	0.95	0.95	0.96	0.96	0.96	0.96	0.96	0.96



Sustainability

DOE Order 430.2B includes several aggressive energy related goals and requirements. Since the criteria for some goals are under development by DOE, their impact and requirements cannot be fully assessed.

BNL will continue to pursue aggressively energy conservation, to meet the intent of this Order to the maximum extent practical. An Initial Proposal (IP) for an ESPC was received in February 2008. BNL plans to take advantage of the ESPC wherever it makes operational and economic sense. BNL is evaluating the proposal and expects there will be issues to be resolved. The Lab's implementation plan will be updated with more accurate information as it becomes available. It must be noted, however, that some goals may not be justifiable economically.

BNL also intends to meet the goals through the use of various funding sources, such as operating, IGPP, NYS funding, and other sources as they are identified.

DOE Order 430.2B Goals

Requirement	Goal	Funding Source	Cost	Milestone	Progress to Date
Energy Reduction of 30%	25%	ESPC	\$30 M	FY 09	ESPC IP currently under review and comment. Current schedule is a delivery order by the end of the year.
	4%	Other	\$500K	FY 15	BNL to develop.
	1%	Operating	\$150K /yr	FY 15	Site-wide lighting re-lamp effort.
Renewable Energy: 7.5% of total site needs	To be determined (TBD)	ESPC	TBD	FY 10	Independent party recently completed initial assessment. May include with ESPC, if viable.
	TBD	Other	TBD	FY 10	Working with NYS to identify a project; installed solar hot water heating system with Federal Energy Management Programs (FEMP) funds
	TBD	Overhead	TBD	FY 10	Considering purchase of renewable source(s) with new electric contract which ends 1/31/09; using biofuel blend for heating systems in several locations.
Operate alt. fuel vehicles on alt. fuel	100%	TBD	TBD	FY 15	25% of vehicles currently use alt. fuels. Light-duty Compressed Natural Gas (CNG) vehicles are no longer available from original equipment manufacturers;

Requirement	Goal	Funding Source	Cost	Milestone	Progress to Date
					BNL is evaluating long-term viability of its CNG vehicle fleet and use of other fuels, such as E85.
Potable Water Reduction of 16%	TBD	ESPC and operating	TBD	FY 10	Since 2003, BNL has achieved a 38% reduction in water use. However, with BNL's low water costs, additional projects may be difficult to justify economically. Some projects may be done under the ESPC, if possible.
Audit 100% of Facilities for sustainability	100%	TBD	TBD	12/31/08	Criteria not yet available; need to identify funding source.
Sustainable Design Standards	15% of space	TBD	TBD	FY 15	Need to perform audit first.
LEED Gold - new construct. and major renovations	LEED Gold	SLI	\$9.7M	New project started 10/1/08	Will attain LEED (Leadership in Energy & Environmental Design) Gold for new projects, including ISB I and ISB II, as long as they are life-cycle cost-effective.
Metering of all water and energy systems	100% electric and thermal	ESPC and operating	TBD	FY 12	80% of electric and thermal currently metered.
Data Center energy reduction	TBD	TBD	TBD	TBD	Awaiting criteria. DOE Transformational Energy Action Management (TEAM) goal is 10% reduction; trend with data centers is increasing energy use.